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Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

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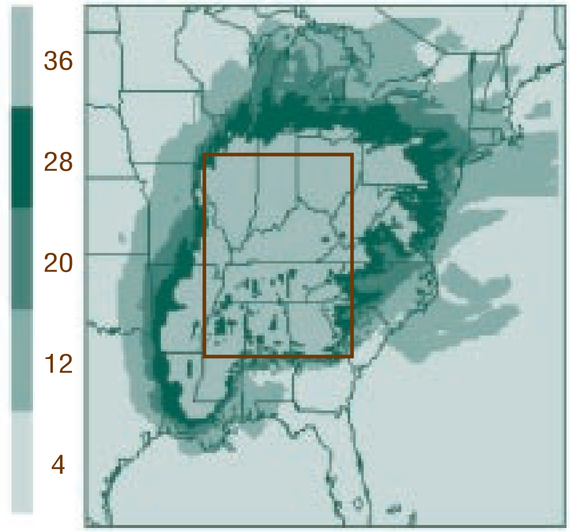
# EPA Regional Approaches to Improving Air Quality

**Air pollution can be transported hundreds of miles downwind from its origin.**




*This model of a July 1991 ozone episode shows how far downwind emissions originating from industrial and mobile sources in the boxed area can be transported.*

# INTRODUCTION

Each individual breathes nearly 13,000 liters (approximately 3,400 gallons) of air every day. Yet the air is being polluted by human activities like driving cars, burning fossil fuels, and manufacturing chemicals, and natural events such as forest fires. These add gases and particles to the air we breathe and, in high enough concentrations, can have harmful effects on people and the environment. Many air pollutants such as those that form urban smog, acid rain, and some toxic compounds remain in the environment for long periods of time and can be transported great distances from their origin.

The struggle for clean air is almost as old as industrialized society. In 1661, John Evelyn and John Graunt of England each published studies associating negative health effects with industrial air emissions. Both researchers described the transport of pollutants between England and France and suggested protecting human health by locating industrial facilities outside of towns and using taller smokestacks to spread "smoke" into "distant parts."

Research continues to show that air pollution can be carried hundreds of miles from its source and can cause health and environmental problems on a regional or even global scale. In people, air pollution can cause burning eyes, irritated throats, difficulty with breathing, long-term damage to the respiratory and reproductive systems, cancer, and, in extreme cases, death. Trees, lakes, crops, buildings, and statues can be damaged by air pollution. Air pollutants also cause haze, impairing visibility in cities, national parks, and other scenic areas.

Under the Clean Air Act, passed by Congress in 1970 and recently amended in 1990, the U.S. Environmental Protection Agency (EPA) sets and enforces air pollutant limits on sources such as power plants and industrial facilities to help protect against harmful health and environmental effects. Although the Clean Air Act is a Federal law, state and local agencies are responsible for implementing many of its requirements.

Specific air pollutants such as sulfur dioxide ($SO_2$), particulate matter, ground-level ozone, and the emissions that form these pollutants can travel great distances from their sources. Since air pollutants do not recognize political boundaries, states and communities cannot independently solve all of their air pollution problems. Resolving air pollution control issues often requires state and local governments to work together to reduce air emissions. The Clean Air Act established groups such as the Ozone Transport Commission in the northeastern U.S. and the Grand Canyon Visibility Transport Commission in the western U.S. to develop regional strategies to address and control air pollution. Many other such groups have also been formed to address the regional transport of air pollutants.

This brochure describes selected air pollutants of regional concern in the U.S. and summarizes ongoing efforts to control them.

**Since air pollutants do not recognize political boundaries, states and communities cannot independently solve all of their air pollution problems.**

# Ground-level ozone

Ozone that occurs naturally in the upper atmosphere surrounding the Earth provides a filter for the damaging ultraviolet light emitted by the Sun. At ground level, ozone is harmful to living things. Ground-level ozone is an air pollutant that damages human health, vegetation, and many common materials. It is a key ingredient of urban smog.

## Sources

Ground-level ozone is not emitted directly into the air, but rather is formed by gases called oxides of nitrogen ($NO_X$) and volatile organic compounds (VOC), which in the presence of heat and sunlight, react to form ozone. Ground-level ozone forms readily in the atmosphere, usually during hot weather. As a result, it is known as a "summer-time" air pollutant. Emissions of $NO_X$ are produced primarily when fossil fuels are burned in motor vehicle engines, power plants, and industrial boilers. There are hundreds of thousands of sources of VOC emissions including automobile emissions, gasoline vapors, chemical solvents, and consumer products like paints.

## Health & Environmental Effects

Repeated exposure to ozone pollution for several months may cause permanent structural damage to the lungs. Because ozone pollution usually forms in hot weather, anyone who spends time outdoors in the summer is at risk, particularly children, moderate exercisers, and outdoor workers. Even when inhaled at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Ground-level ozone is also responsible for 1 to 2 billion dollars in reduced crop production in the U.S. each year. Because ground-level ozone interferes with the ability of plants to produce and store food, they are more susceptible to disease, insects, other pollutants, and harsh weather. Ozone also damages the foliage of trees and other plants, ruining the appearance of cities, national parks, and recreation areas.

## Regional Transport

Under the Clean Air Act, EPA has set acceptable levels, called National Ambient Air Quality Standards, for ozone in the air we breathe. Some parts of the U.S. are currently unable to meet these standards. These areas are described as "nonattainment" areas. Tens of millions of Americans live in ozone "nonattainment" areas, primarily in parts of the Northeast, Lake Michigan area, Atlanta, southeastern Texas, and parts of California. Many of these nonattainment areas have focused a great deal of effort on reducing VOC and, in some cases, $NO_X$ emissions from stationary (factories) and mobile (vehicles) sources within their jurisdictions. In several cases, emission controls are not producing the reductions in ground-level concentrations of ozone needed to meet the national health standard.

$$\text{VOC} + NO_x + \text{Heat} + \text{Sunlight} = \text{Ozone}$$

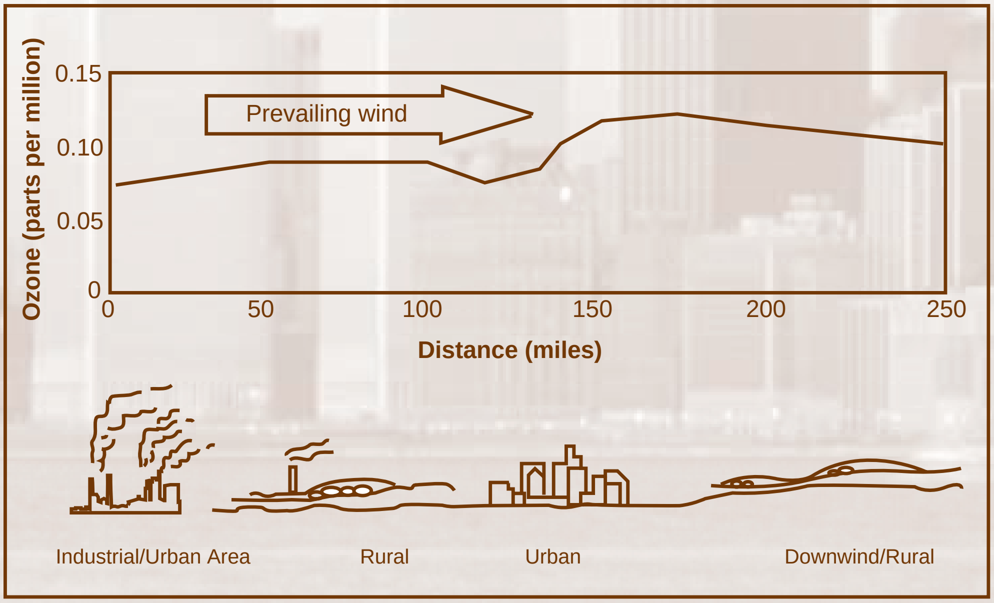
*According to this simplified equation, volatile organic compounds and oxides of nitrogen react, in the presence of heat and sunlight, to form ozone.*

Ozone "precursors," such as $NO_X$ emissions, as well as ozone itself, can be carried hundreds of miles from their origins, causing air pollution over wide regions. Although many urban areas have made efforts to control ozone by reducing local $NO_X$ and VOC emissions, incoming ozone transported from upwind areas also needs to be addressed in order to meet the National Ambient Air Quality Standards. High levels of ozone entering some nonattainment areas can make achieving the national ozone standard difficult and costly, unless upwind sources are identified and controlled. If these sources fall within a certain state's boundaries, it can take measures to control them. If, as is often the case, these sources fall beyond the political boundaries of that state, it must work with EPA and other states to reduce air pollution on a regional scale. Often, it is more cost-effective to reduce emissions from upwind sources than to control emissions from smaller and smaller businesses in the nonattainment areas being affected downwind.

Some regional strategies for reducing ground-level ozone include:

- *reducing $NO_X$ emissions from power plants and industrial combustion sources*
- *introducing low-emission cars and trucks*
- *burning gasoline reformulated to reduce VOC, $NO_X$, and other emissions.*

GROUND-LEVEL OZONE IS ALSO RESPONSIBLE FOR 1 TO 2 BILLION DOLLARS IN REDUCED CROP PRODUCTION IN THE U.S. EACH YEAR. BECAUSE GROUND-LEVEL OZONE INTERFERES WITH THE ABILITY OF PLANTS TO PRODUCE AND STORE FOOD, THEY ARE MORE SUSCEPTIBLE TO DISEASE, INSECTS, OTHER POLLUTANTS, AND HARSH WEATHER.




*Ozone, VOC, and $NO_x$ air emissions from upwind industrial/urban areas contribute to ozone concentrations hundreds of miles downwind in rural and other urban areas. When combined with local air emissions, regionally transported ozone causes some areas to exceed the National Ambient Air Quality Standards (NAAQS) for ozone.*

# Particulate Matter

Evidence from community studies links particulate exposure to premature death, increased hospitalization, school absence, and lost work days due to respiratory and cardiovascular diseases like asthma.

Particulate matter, which includes solid particles as well as liquid droplets found in the air, can be described as "haze." Breathing particulate matter can cause serious health problems. Particulates also reduce visibility in many parts of the U.S. They can also accelerate corrosion of metals and damage paints and building materials such as concrete and limestone.

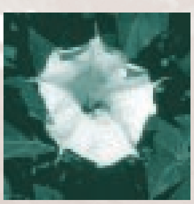
## Sources

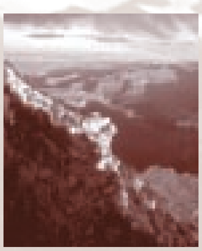
Particulate matter comes from a variety of sources. Some particles are emitted directly from their sources such as smokestacks and cars. In other cases, gases such as sulfur oxide, $SO_2$, $NO_x$, and VOC interact with other compounds in the air to form particulate matter. As a result, the chemical and physical composition of particles varies widely. "Coarse" particles are larger than 2.5 micrometers and generally come from sources such as vehicles traveling on unpaved roads, materials handling, crushing and grinding operations such as cement manufacturing, and combustion sources. Particles less than 2.5 micrometers (0.0004 inch) in diameter are known as "fine" particles. Fine particles result from fuel combustion in motor vehicles, power plants and industrial facilities, residential fireplaces, woodstoves, wildfires, and prescribed forest burning. Fine particles can also be formed in the atmosphere from gases such as $SO_2$, $NO_X$, and VOC.

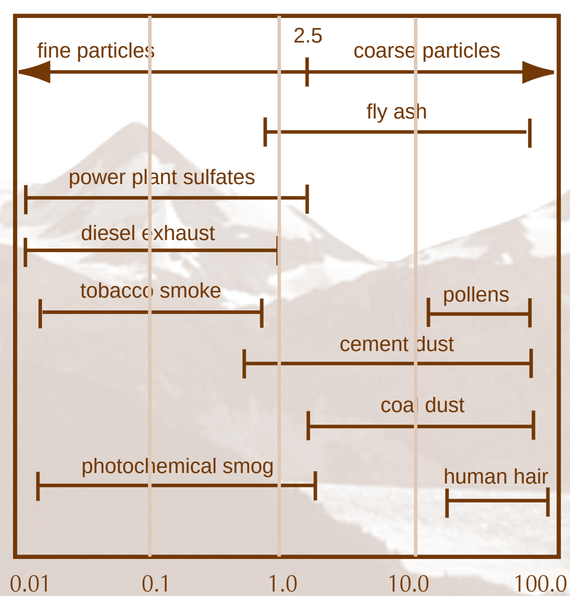
## Health & Environmental Effects

Particulate matter less than 10 micrometers in size, including fine particles less than 2.5 micrometers, can penetrate deep into the lungs. On a smoggy day, one can inhale millions of particles in a single breath. Tens of millions of Americans live in areas that exceed the national health standards for particulates. In recent studies, exposure to particulate pollution — either alone or with other air pollutants — has been linked with premature death, difficult breathing, aggravated asthma, increased hospital admissions and emergency room visits, and increased respiratory symptoms in children. People most at risk from exposure to fine particulate matter are children, the elderly, and people with chronic respiratory problems.

Fine particles scatter and absorb light, creating a haze that limits our ability to see distant objects. Some particles, such as sulfates and nitrates, grow in size as humidity








*This schematic shows the general size range of selected airborne particles in micrometers. The size range of a human hair is also indicated. (Not drawn to standard scale.)*

in the air increases, which increases the amount of haze and reduces visibility. Particle plumes of smoke, dust, and/or colored gases that are released to the air can generally be traced to local sources such as industrial facilities or agricultural burning. Regional haze is produced by many widely dispersed sources, reducing visibility over large areas that may include several states.

## Regional Haze

Chemical reactions of air pollutants and weather conditions can create fine particles, which can remain in the air for several days and be transported great distances. As a result, fine particles transported from urban and industrial areas may contribute significantly to impaired visibility in places, such as national parks, valued for their scenic views and recreational opportunities.

Sources of regional haze vary from region to region. In the eastern U.S., for example, sulfates from power plants and other large industrial sources play a major role. In the western U.S., nitrates, sulfates, organic matter, soot, and dust emitted by power plants, motor vehicles, petroleum and chemical industrial facilities, wildfires, and forest-management burning, all contribute to reduced visibility.

Visibility conditions vary across the country. With a few exceptions, much of the eastern U.S. has poorer visibility than the western U.S. because of higher levels of particles from manmade and natural sources, as well as the effect of higher humidity levels on those particles. Visibility in the eastern U.S. should naturally be about 90 miles, but air pollutants have reduced this range from 14 to 24 miles. In the western U.S., visual range should be approximately 140 miles, while current conditions limit it to 33 to 90 miles. Visibility also varies seasonally and is generally worse during the summer months, when humidity is higher and the air is stagnant.

The Clean Air Act established special goals for visibility in some national parks and wilderness areas. In 1994, EPA began developing a regional haze program that is intended to ensure that continued progress is made toward the national visibility goal of "no manmade impairment." Such control efforts would likely result in improved public health protection and visibility in areas outside national parks as well.

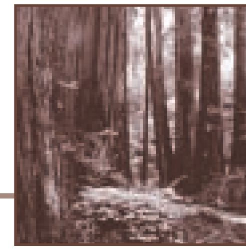
Examples of regional strategies for reducing fine particulate levels include:

- *reducing particulate emissions by conserving energy and promoting renewable energy sources like solar- and wind-powered energy*
- *controlling $SO_2$ emissions from power plants and industrial sources*
- *reducing particulate emissions from diesel truck and bus exhaust*
- *reducing controlled burning to manage undergrowth in forested areas.*

EPA's "regional haze" program is intended to ensure continued progress is made toward the national visibility goal of "no manmade impairment."

*Visibility impairment in Acadia National Park, Maine.*

# ACID RAIN



## Chesapeake Bay

*Chesapeake Bay is the largest estuarine system in the continental U.S. and is home to more than 2,000 species of fish, shellfish, and wildlife. Increasing levels of nitrogen compounds in the Bay are harming this aquatic ecosystem. The influx of higher than normal amounts of nutrients (e.g., nitrogen, phosphorous) allows excessive growth and reproduction of algae, eventually changing aquatic systems by depleting dissolved oxygen and decreasing light penetration to submerged plants.*

*Recent research concludes that air pollution from power plants is a significant source of nitrogen in the Chesapeake Bay. Studies show that 27 percent of the total nitrogen deposited in the Chesapeake Bay and tidal tributaries is from transport and deposition of air pollutants. Similarly, hundreds of other estuaries such as Puget Sound, Washington and Pamlico Sound, North Carolina, are suffering from effects of excess nitrogen.*

*The Chesapeake Bay Agreement, a cooperative action among the U.S. EPA, Maryland, Pennsylvania, Virginia, and the District of Columbia, was enacted to reduce and control pollution sources affecting water quality in the Bay. Goals of the agreement are to achieve a 40 percent reduction in nutrients, such as nitrogen, being input to the Bay by the year 2000 and to cap those inputs at 60 percent of 1985 levels. States participating in the agreement are evaluating how reductions in $NO_x$ air emissions will help achieve these goals.*

Acid rain is formed when sulfur dioxide ($SO_2$) and oxides of nitrogen ($NO_x$) are released into the air. While airborne, $SO_2$ and $NO_x$ gases and particles contribute to visibility impairment and impact human health. These gaseous compounds react with other substances in the atmosphere to form weak acids and fall to earth as rain, fog, snow, or dry particles. They cause lakes and streams to become acidic and unsuitable for many fish, damage forests, and cause deterioration of cars, buildings, and historical monuments.

## Sources

By far, power plants burning coal, oil, and natural gas are the primary source of $SO_2$ emissions. In the U.S., 70 percent of $SO_2$ emissions come from such plants. Nitrogen oxides are emitted into the air from cars and trucks, coal-burning power plants, and industrial combustion operations such as boilers and heaters.

## Regional Transport & Environmental Effects

In the past, industrial facilities and power plants had shorter smokestacks. When air pollution from these stacks settled in populated areas near the plants and caused sickness, stacks were built much higher. At that time, many believed that if the air pollutants were sent high into the atmosphere, they would no longer be a problem. We now know that emissions released high in the atmosphere can be transported great distances. The Ohio River Valley, where power plants burn high-sulfur coal, leads the U.S. in emissions of $SO_2$ and $NO_x$. Consequently, areas receiving the most acid rain are downwind (generally northeast) of the Ohio River Valley. The ecological effects of acid rain depend on both the total amount of acid rain deposited in an area and its soil characteristics. Some soils, such as those generally found in most of the Midwest, contain acid-neutralizing compounds. These areas can be exposed to years of acid deposition without experiencing significant environmental problems. But the thin soils of the northeastern mountains have very little acid-buffering ability, making this area, along with eastern Canada, vulnerable to acid rain damage. Other areas along the Appalachians, as well as certain high elevation western areas, are also sensitive to acid deposition.

Lower pH levels have been found in aquatic systems of the northeastern U.S., indicating higher acidity. These conditions can interrupt reproductive cycles of aquatic plants and animals. Acid deposition can also filter through soils, pick up toxic metals as it passes through, and carry them to lakes and streams, where they accumulate and affect the aquatic food chain.

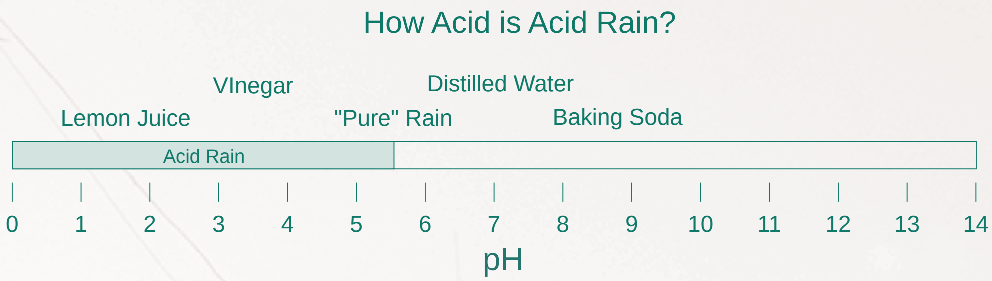
*Statue ruined by acid deposition. Photograph courtesy of the National Park Service.*

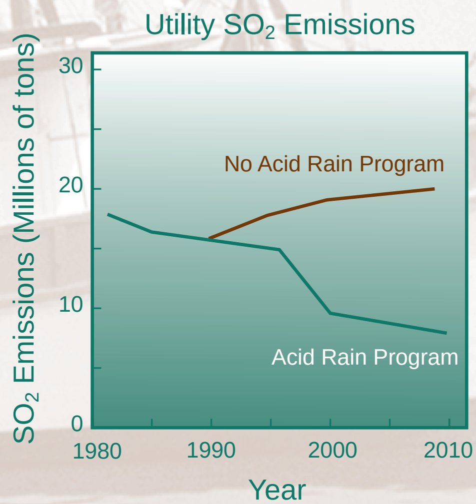
# Reducing Acid Rain

The Clean Air Act Amendments of 1990 require major reductions in $SO_2$ and $NO_X$ emissions and establish a market-based approach to managing emissions of $SO_2$. Coal-fired electric power plants are the primary target for reducing these pollutants in the U.S. Beginning in 1995 (Phase I), EPA allocated a limited number of "allowances" to 445 electric power plants. These plants can emit up to one ton of $SO_2$ emissions during a 1-year period for each allowance. Allowances can be bought, sold, or traded among utilities, brokers, or others. Utilities must ensure that their emissions do not exceed the allowances they hold. Pollution control equipment, the use of low-sulfur coal, and implementation of energy-efficient measures such as home insulation programs and energy-efficient lighting are ways power plants can reduce their $SO_2$ emissions. In the year 2000, Phase II tightens the annual $SO_2$ emissions on the large high-emitting Phase I plants and sets restrictions on smaller, cleaner plants.

By 2010, EPA's Acid Rain Program and the utility industry expect to achieve a 10 million ton reduction from 1980 $SO_2$ emission levels.

The Clean Air Act also calls for a 2 million ton reduction in $NO_X$ emissions by the year 2000, a significant portion to be achieved by installation of controls on coal-fired utility plants.



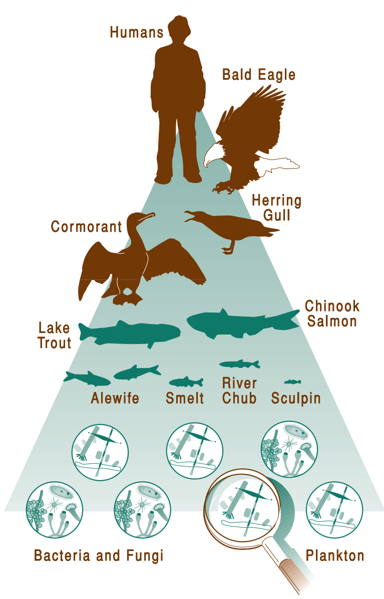




*By the year 2010, EPA's Acid Rain Program is expected to reduce $SO_2$ emissions 10 million tons from 1980 levels.*

*Although not obvious to the casual observer, many lakes have been affected by acid deposition. Big Rock Lake in the southwestern Adirondacks of New York State has been harmed by acid rain over the last several decades. Fish populations have been severely impacted.* (Source: *Adirondack Lakes Survey Corporation Interpretive Report*, 1990. Photograph courtesy of the Adirondack Council.)

# Toxic Air Pollutants

Within the next 10 years, the national toxic air pollutant program is expected to lower emissions of toxic pollutants 75 percent and thus reduce adverse human health and ecosystem effects.




***Simplified aquatic food web.*** *Persistent pollutants do not break down easily in the environment. They accumulate in body tissues and concentrate at each step of the food chain.*

Toxic air pollutants are known to cause or are suspected of causing cancer, adverse reproductive, developmental, and central nervous system effects, and other serious health problems. The Clean Air Act lists 188 toxic air pollutants as hazardous. Examples of toxic air pollutants include heavy metals like mercury and lead, manmade chemicals like polychlorinated biphenyls (PCB), polycyclic organic matter (POM), dioxin and benzene, and pesticides like dichlorodiphenyl-trichloroethane (DDT). Some toxic air pollutants remain in the environment for only short periods of time. These pollutants, including compounds such as formaldehyde, toluene, and benzene, generally impact human health and the environment near emission sources. Other toxic air pollutants, such as lead, mercury, PCB, and DDT, break down slowly, if at all, in the environment and can be redeposited many times. Additionally, they build up in the body and concentrate as they rise through the food chain. Many of these "persistent" pollutants, emitted from various sources including motor vehicles and industrial facilities, are appearing in unexpected locations far away from their sources, including the Great Lakes, Lake Champlain, and the Chesapeake Bay.

## Reducing Toxic Air Pollutants

EPA has identified 174 categories of sources that emit one or more of the 188 toxic air pollutants. These sources will be required to reduce emissions over the next 10 years. Since 1990, EPA's toxic air pollutant program has issued a number of rules to control toxic air releases from approximately 50 categories of sources. These include large industrial complexes such as chemical plants, oil refineries, and steel mills and smaller sources such as dry cleaners and commercial sterilizers. One of these rules applies to the organic chemical manufacturing industry, which produces chemicals used in many industrial processes. This rule alone will reduce emissions of toxic air pollutants by over half-a-million tons annually (a 90 percent reduction) and will lower smog-causing VOC by about 1 million tons annually (an 80 percent reduction). Within the next 10 years, EPA's national program is expected to lower emissions of toxic air pollutants 75 percent.

## Sources

Metals and other toxic air pollutants that persist in the environment and are transported over broad regions come from a variety of sources. Mercury, for example, is a toxic metal that comes from both natural and manmade sources. Coal-fired power plants, municipal waste incinerators, medical waste incinerators, and cement kilns that burn hazardous waste or coal are among the major manmade sources of mercury. Natural sources of atmospheric mercury include gases released from the Earth's crust by geysers, volcanic eruptions, and forest fires. PCB are industrial chemicals used widely in the U.S. from 1929 until 1978 as coolants and lubricants and in electrical equipment. The manufacture of PCB in the U.S. stopped in 1977, and use was restricted in 1979. POM includes a number of cancer-causing products of incomplete combustion and can come from diesel engines and other motor vehicles, wood burning, and industrial burning of fossil fuels. DDT is an insecticide that was widely used in this country from 1946 until 1972. DDT is still used in other countries and, by special permit, in the U.S. Many VOC and fine particulates are also toxic air pollutants. Controlling air concentrations of ozone and particulate matter has the added benefit of reducing toxic air pollutants.

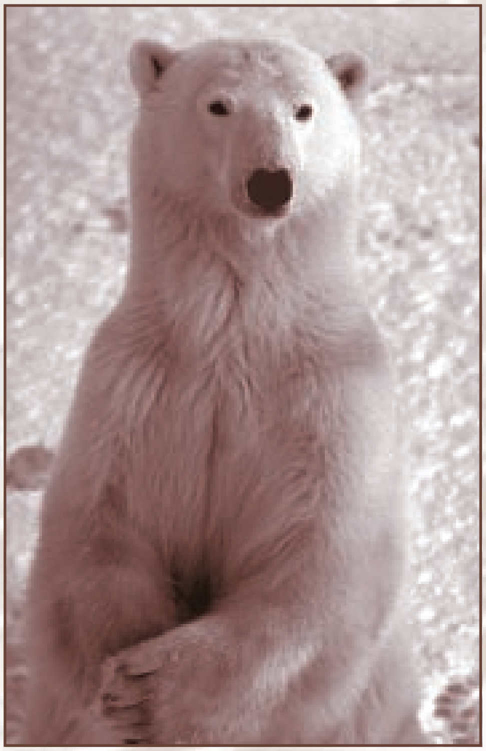
# Health & Environmental Effects

At certain levels, toxic air pollutants can cause human health effects ranging from nausea and difficulty in breathing to cancer. Health effects can also include birth defects, serious developmental delays in children, and reduced immunity to disease in adults and children. Toxic air pollutants can also be deposited onto soil or into lakes and streams where they affect ecological systems and can eventually affect human health when consumed in contaminated food, particularly fish.

For example, people who regularly consume fish from the Great Lakes have been found to have higher concentrations of PCB, DDT, and other toxic chemicals in their bodies than people who do not. Fish-eating birds, mammals, and reptiles have experienced a variety of adverse effects associated with chemical pollution.

# Long-Range Transport

Scientific studies conducted over the past 30 years consistently indicate that toxic air pollutants can be deposited at locations far from their sources. For example, a number of toxic air pollutants persist in the environment and concentrate through the food web, including toxaphene, a pesticide used primarily in the cotton belt, and have been found in fatty tissues of polar bears and other Arctic animals thousands of miles from any possible source. Lead and other trace metals have been measured in the air and rainfall at remote locations over the Atlantic and Pacific Oceans, great distances from likely sources. Core samples from peat bogs in the Great Lakes region show deposition of new releases of DDT. Since DDT is used only under special conditions in the U.S., this toxic compound may be originating from sources as far away as Mexico or Central America. Fortunately, Mexico has recently banned the use and production of DDT.



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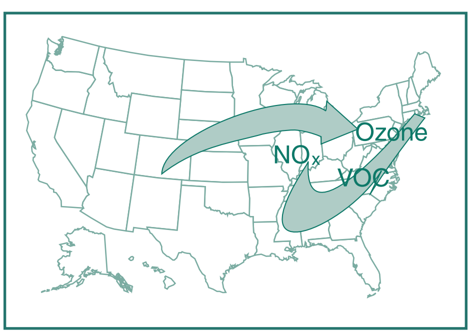
# Regional Efforts to

Several regional organizations have been formed to address problems associated with long-range transport of air pollution. These organizations are described in the summaries below.

## Ozone Transport Commission (OTC)

The 1990 Clean Air Act Amendments established the OTC and the Northeast Ozone Transport Region in recognition of long-standing regional ozone problems in the northeastern U.S. The Commission comprises the governors or their designees and an air pollution control official from each of 12 states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia) and the District of Columbia. Administrators for three northeastern EPA Regions also participate.

The OTC states have agreed on a number of steps to reduce regional air pollution. For example, they have agreed to introduce a low-emission vehicle (LEV) program similar to that in California, which includes five categories of vehicles that meet increasingly stringent emissions standards. The OTC, automobile manufacturers, and EPA are also working on an agreement for a national LEV program, which would bring "cleaner cars" to all states, not just those in the northeastern U.S. The OTC has also agreed to significantly reduce $NO_x$ emissions throughout the region from large stationary sources such as power plants and other large fuel combustion sources, using a market-based approach. By 1999, $NO_x$ emissions in the OTC states are expected to be reduced by approximately 52 percent from the 1990 baseline.




*Regional ozone transport*

## Ozone Transport Assessment Group (OTAG)

OTAG includes 37 states east of the Rocky Mountains. It is convened by the Environmental Council of States (an organization comprised of state environmental commissioners) for analyzing long-range transport of ozone and the compounds that form ozone. The goal of OTAG is to identify and recommend to EPA cost-effective control strategies for VOC and $NO_x$ to facilitate compliance with the National Ambient Air Quality Standards for ozone. OTAG includes representatives from states with and without areas that fail to meet the national ozone standards. EPA, industry representatives, public health advocates, and environmentalists are also included in OTAG discussions. OTAG's regional-scale ozone modeling shows that transport plays an important role in local levels of ozone. OTAG is expected to complete its analyses and make its recommendations to EPA in 1997.

## Grand Canyon Visibility Transport Commission (GCVTC)

GCVTC was established by EPA in 1991 to advise on strategies for protecting visual air quality at national parks and wilderness areas on the Colorado Plateau. The Commission includes governors of Arizona, California, Colorado, Nevada, New Mexico, Oregon, Utah, and Wyoming, and representatives of the Hopi Tribe, Navajo Nation, Acoma Pueblo, Hualapai Tribe, and the Columbia River Inter-Tribal Fish Commission. Federal agencies, including the Department of Agriculture, the Department of the Interior, and EPA are also represented.

In 1996, the Commission released recommendations for improving visibility on the Colorado Plateau, including:

- *establishing an emissions cap/target for the region and an emissions trading program to keep the region within the cap*
- *decreasing mobile source emissions*
- *minimizing visibility impairment from controlled burning*
- *identifying areas called "clean air corridors" as important sources of clean air for national parks and other scenic vistas (sources of particulate emissions will be closely monitored in these areas).*

EPA expects to pursue methods for implementing these recommendations including continued regional coordination and development of regional haze rules.

## Southern Appalachian Mountains Initiative (SAMI)

SAMI is a nonprofit, voluntary organization formed in 1992 to address regional air quality problems in southern Appalachia, particularly in high elevations, national parks, and recreation areas. Groups involved in this effort include Federal, state, and local agencies; environmental and industrial representatives; academic institutions; and private citizens. SAMI is identifying options for managing air emissions in the southern Appalachians, with special attention focused on how these options could affect the regional environment and economy. SAMI is expected to complete its analysis and make recommendations to states by 1999 on control strategies for pollutants that cause acid rain, visibility impairment, and ground-level ozone in the southern Appalachians.

## Lake Michigan Ozone Study (LMOS) and Ozone Control Program (LMOP)

In 1989, EPA and the states of Illinois, Indiana, Michigan, and Wisconsin signed an agreement to study the ozone air quality problem in the Lake Michigan region. In 1991, this group signed a second agreement to establish control measures to improve regional air quality. These efforts have contributed to a regional understanding of ozone transport, as well as determining the steps necessary to control air pollutants that form ground-level ozone. Recent accomplishments of this group include developing and applying a state-of-the-art model for examining the transport of ozone in the Lake Michigan region, supporting initial state implementation plan efforts to control ozone-forming air pollutants for the four Lake Michigan states, and working cooperatively with other states as part of the OTAG discussions.

## North American Research Strategy for Tropospheric Ozone (NARSTO)

NARSTO is a 10-year research program, chartered in 1995 as a public/private partnership. It includes researchers and policy makers of over 70 organizations from government, utilities, industry, and academia throughout Mexico, the U.S., and Canada. The goal of NARSTO is to develop a scientific and technological basis for managing ground-level ozone. NARSTO plans to publish its first Ozone State-of-Science Assessment Document in 1998, in which it will address assessment issues including:

- *significant research developments relating to ground-level ozone in the last 10 years*
- *urban and regional sources of VOC and $NO_x$ emissions and transport of ozone*
- *the effectiveness of existing emission control measures.*

As a science-focused research program based on international cooperation, NARSTO will continue to be important in the resolution of long-range ozone transport problems across North America.

## Southern Oxidants Study (SOS)

The SOS, established through cooperative agreements in 1991, is long-term, academic research designed to provide a better understanding of how ozone forms in the southeastern U.S. In addition to major academic institutions like the Georgia Institute of Technology and North Carolina State University, the private sector and Government have also played a significant role in the overall partnership. The Electric Power Research Institute, the National Oceanic and Atmospheric Administration, the Tennessee Valley Authority, EPA, and many state and local Southeastern environmental agencies and companies participated in major research programs in the metropolitan areas of Atlanta (1992) and Nashville (1994-95). As part of these efforts, data gathered at monitoring sites has provided insight into ground-level ozone formation in the Southeast and around the country.

## Integrated Atmospheric Deposition Network (IADN)

The IADN is a U.S./Canadian cooperative effort that involves toxic air pollutant monitoring. This network consists of five monitoring stations, one placed on each of the Great Lakes, that gather data on atmospheric concentrations of toxic air pollutants such as the pesticides lindane and dieldrin, heavy metals including lead and

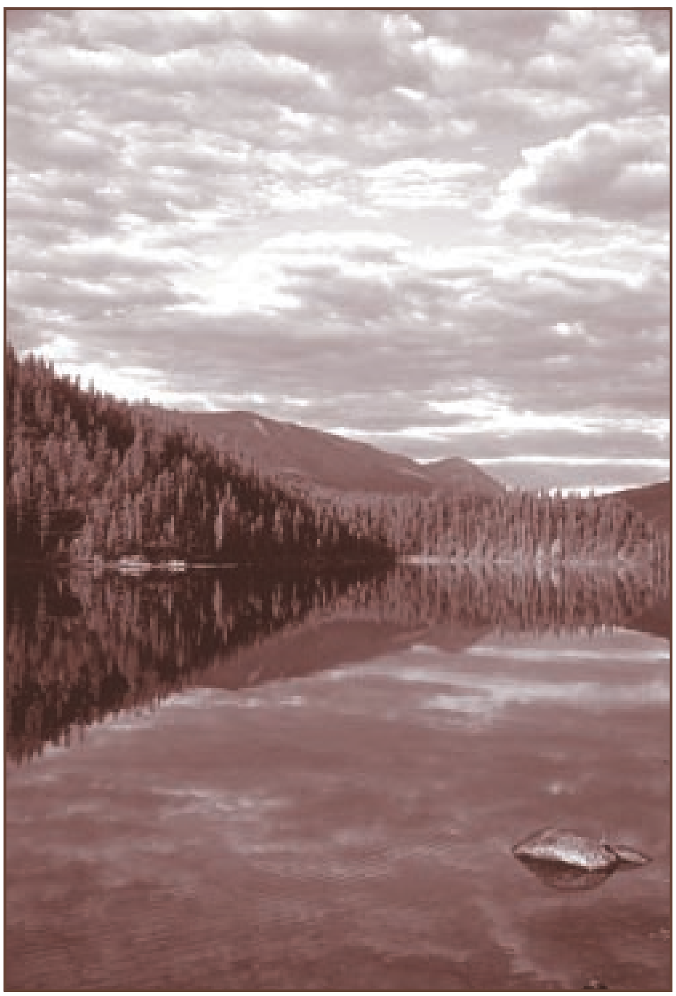
Polycyclic Aromatic Hydrocarbons. These monitors help determine the atmospheric contribution of these compounds to the concentrations found in the Great Lakes ecosystem. IADN helps to identify trends in concentrations of toxic air pollutants, assists in determining how to reduce toxic air emissions, and supports research toward understanding the effects of toxic air pollutants on the Great Lakes.

## International Efforts

There are several other important cooperative efforts underway to address air pollution that crosses our national boundaries with Canada and Mexico. Under the La Paz Agreement, the U.S. and Mexico work to analyze and reduce air pollution in communities along our common border. Similarly, the U.S. and Canada have signed an air quality agreement to address air pollution issues of mutual concern, such as acid rain and ozone transport, and they also have embarked on a strategy to reduce and eliminate certain persistent toxic pollutants such as mercury and PCB. The North American Free Trade Agreement established the Commission for Environmental Cooperation to foster joint air pollution control efforts among all three countries and to ensure that pollution created in one country does not affect the health of the citizens and the environment in another. These efforts to date include establishing and upgrading monitoring networks along the U.S./Mexico border, developing a system for the U.S. and Canada to notify each other of major new sources of air pollution, and establishing an international air quality management commission to address pollution in the El Paso, Texas and Juarez, Mexico area.

# CONCLUSION

To effectively control air pollution, the U.S. Congress, EPA, and states have recognized the need for regional, as well as national and local, cooperation. Since air pollution does not respect political boundaries, regional approaches are often among the most effective ways to control its transport. The overall quality of the nation's air continues to improve, despite increases in population, gross national product, and vehicle miles traveled. Efforts to maintain and build on this progress into the 21st century will require continued cooperation among international, national, state, tribal, and local governments, as well as industry, environmental groups, and private citizens.



## ACRONYMS

- DDT - Dichlorodiphenyl-trichloroethane
- EPA - U.S. Environmental Protection Agency
- GCVTC - Grand Canyon Visibility Transport Commission
- IADN - Integrated Atmospheric Deposition Network
- LEV - Low Emission Vehicle
- LMOP - Lake Michigan Ozone Control Program
- LMOS - Lake Michigan Ozone Study
- NARSTO - North American Research Strategy for Tropospheric Ozone
- $NO_x$ - Oxides of Nitrogen
- OTAG - Ozone Transport Assessment Group
- OTC - Ozone Transport Commission
- PCB - Polychlorinated Biphenyls
- POM - Polycyclic Organic Matter
- ppm - parts per million
- SAMI - Southern Appalachian Mountains Initiative
- $SO_2$ - Sulfur Dioxide
- SOS - Southern Oxidants Study
- VOC - Volatile Organic Compounds

# For More Information on Regional Air Pollution Transport Contact:

## *EPA Headquarters*

**U.S. EPA**
401 M Street, SW
Washington, DC 20460
202-260-2080
Homepage: http://www.epa.gov/docs/oar/oarhome.html

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San Francisco, CA 94105
415-744-1264

**U.S. EPA Region X** (Idaho, Washington, Oregon, Alaska)
1200 Sixth Avenue
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## *Other Organizations Discussed*

**Grand Canyon Visibility Transport Commission**
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Denver, CO 80202-5452
303-623-9378

**Integrated Atmospheric Deposition Network**
77 W. Jackson Boulevard, MC-G-9J
Chicago, IL 60604
312-353-2000

**Lake Michigan Ozone Study and Control Program**
2350 East Devon Avenue, Suite 242
Des Plaines, IL 60018
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**North American Research Strategy for Tropospheric Ozone**
4811 West 18th Avenue
Kennewick, Washington 99337
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Homepage: http://narsto.owt.com/Narsto

**Ozone Transport Assessment Group**
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202-624-3660
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**Ozone Transport Commission**
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Homepage: http://www2.ncsu.edu/ncsu/CIL/souther_oxidants/

**United States**
**Environmental Protection Agency**
Office of Air Quality Planning and Standards (MD-10)
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